472 are placed at 90 degree increments around a base **474** of the controller to provide linear force and/or motion to the central vertical post **476**. The post can be moved linearly by the user in the x- and/or y-directions to control a cursor, value, etc. It should be noted that the embodiments shown in FIGS. **8***a*-**8***d* can be used with standard, larger-sized joysticks as well as trackpoint controllers, or other types of interface devices.

[0107] Tactile arrays are multiple vertical "pins" that form a plane of contact perpendicular to the orientation of the pins at the pin's contact surfaces. The contact surfaces of the pins are contacted by a user's fingers or palm. Each pin can be individually moved perpendicularly to the pin's lengthwise axis, such that collectively the pins can be moved to convey different tactile sensations to the user. FIG. **9***a* shows a single "pin" **490**, which is implemented as an EAP actuator **494** that can be linearly moved as indicated by arrow **496**. A tactile cap **492** is positioned on the EAP pin **494** to be contacted by a user. In FIG. **9***b*, a plurality of the pins **490** of FIG. **9***a* have been positioned in a matrix to form a tactile array **500**, where each pin **490** can be individually controlled to move vertically in either direction. An adjacent surface **502** provides a reference surface for the user's fingers. In FIG. **9***c*, a high density array **504** of EAP pins **490** is shown, where each EAP pin can represent a pixel-sized element. This array of pins can be used to indicate haptically to the user when certain features in a graphical environment are crossed or interacted with. For example, the array can be provided as a trackpad, where the position of the user's finger on the array determines the position of a cursor or entity in a graphical environment. The array of pins can be matrix scanned (or individually addressed) to sense where the user's finger current is on the array. When the user's finger moves over a border of a window, the EAP pins corresponding to the border location are moved upwards, giving the user's finger the sensation of crossing over a 3-D border. Other displayed features such as icons, folders, etc. can also be similarly haptically indicated. The high density array **504** can also be used to provide other tactile sensations based on interactions or events implemented in a computer environment.

[0108] FIG. **9***d* shows another embodiment **510** using the EAP pins described above. A lateral motion tactile element/array can be provided, where tactile sensations are provided moving pins perpendicular to their lengthwise axes (laterally). Each pin is moved laterally to provide stretching of the user's skin or shear sensations instead of indenting the skin of the user as in the embodiments of FIGS. **9***a*-**9***c*. More space can be provided between the pins to allow for the lateral motion. When using EAP actuators, one way to provide such lateral motion is to place two linearly-moving EAP actuators **512** on a grounded element, and place a flexible membrane **514** (or other member) over the actuators **512**, where a lateral moving element **516** is placed on the flexible membrane **514** as shown in FIG. **9***d*. One or both of the EAP actuators **512** is moved vertically (if both are moved, it is in opposite directions), causing the flexible membrane to flex and the lateral element **516** to rock left or right as indicated by arrow **518**. Alternatively, as shown in FIG. **9***e*, an EAP structure **520** that can be directly moved laterally using a control signal, such as referred to above in FIG. **2***b* and/or an element having sandwiched layers, can be used to provide the desired lateral motion. The actuator **520** can be moved laterally in one degree of freedom, or in some embodiments can be moved in two.

[0109] EAP actuators can be used to provide specific forces in particular applications. For example, FIG. **10** is a side elevation view of an EAP brake **530** used in a medical device, where a catheter wire **532** (or laparoscopic extension, needle, or other portion of medical or other instrument) is used in a haptic feedback medical simulation that provides forces on the medical instrument to simulate a medical procedure. An EAP brake includes an EAP element **534** that is coupled to a brake shoe **536** that can be moved laterally against the catheter wire **532**, causing friction in the linear degree of freedom of the wire. The amount of friction can be adjusted by moving the EAP brake different distances. Another EAP brake can be used to provide resistance in the rotary degree of freedom of the wire **532**.

[0110] Trigger devices can also make use of EAP actuators. FIG. **11** is a side elevational view of a device **540** including a trigger **542** that is pressed by a user to provide a signal to a game, simulation, or other program or device. The trigger **542** can be included in an interface device such as a gamepad, joystick, mouse, etc. For example, the trigger **542** can rotate about an axis of rotation B, which can be a coupling to a housing of the interface device. An EAP actuator **544** can be positioned between the trigger and a grounded switch **546**. The switch **546** sends a signal indicating activation when a portion **548** is pressed. A spring **550** normally biases a contact plate **552** away from the switch **546**; when the plate **552** is moved by the EAP actuator **544**, the spring is compressed and the plate hits the portion **548** of the switch **546**, activating it. The spring **550**, meanwhile, biases the trigger back to its origin or rest position as well as providing a spring resistance force to trigger motion. The EAP actuator can be used to move in opposition to, or in conjunction with, trigger motion to provide a haptic sensation to the user pushing the trigger (this EAP force can supplement or override the spring force from **550**). The actuator can thus make it easier or more difficult for the trigger to cause the switch to change states. For example, different resistances, damping, pulses, or vibrations can be output, as in all the linear EAP actuator embodiments described herein.

[0111] FIG. **12***a* shows a rotary knob **560** that can be used to control functions in a wide variety of devices. A spiral or coil EAP actuator **562** can be positioned inside the knob so that the EAP actuator exerts a torque on the knob when it is activated. Resistance or force can thus be provided in the rotary degree of freedom of the knob, as indicated by arrow **564**, although a knob of limited rotational range should be used.

[0112] FIG. **12***b* illustrates a knob device **570** that includes an EAP actuator. Knob **572** is coupled to a rotating shaft **574**, which is coupled to a cylindrical brake member **576** that can include a frictional surface. EAP actuator **578** includes a brake shoe **580** that is moved by the actuator **578** to contact the brake member **576**. This engagement provides frictional forces on the shaft **574** and knob **572**. This embodiment allows a knob having an unlimited (continuous) rotational range to be used. A linear EAP element can be used, as described in braking embodiments above.

[0113] FIG. **13** is a side elevational view of a braking embodiment **590** for a rotating disk. Disk **592** rotated about axis C. A caliper **594** is positioned at one end of the disk, and an EAP actuator **596** is coupled to one end of the caliper. The EAP actuator can be moved linearly to move a brake shoe **598** against the spinning cross-sectional surface of the disk, thus causing frictional resistance to the disk. A brake shoe **600** can be positioned on the other end of the caliper **594**, opposite the